

# Metal Oxide Aerogels

*Space-age aerogel catalytic converters for cleaner air from autos, trucks, and industry*

The combination of current market forces and technology have led to an era where custom-designed catalysts are both necessary and possible. For example, Clean Air Act standards for motor vehicle emissions have led to an effort to develop advanced catalysts and catalytic converter systems. Use of catalysts for emission controls for stationary sources, such as power generating stations, is projected to grow by 25% a year. The market for catalysts is several billion dollars a year.

Research at LLNL has made it possible to incorporate virtually any transition metal into lightweight, honeycombed, open-cell foam materials called aerogels. We have begun the difficult task of incorporating noble metals and have

recently succeeded in incorporating platinum into the aerogel structure.

We can control the amount, location, and concentration of the metal for varied effects. An aerogel that contains only a few atoms of a metal, such as platinum, will have a different catalytic effect, with different applications, than one with concentrations of thousands of platinum atoms.

## APPLICATIONS

- Automobiles: "lean burn" catalytic converters
- Trucks: catalytic converters to reduce nitrogen oxide emissions
- Aerospace: increased jet engine efficiency
- Industry: catalytic processing and effluent reduction

## Lower manufacturing costs, improved products

Using aerogels to produce catalytic converters may result in lower cost, because less material and time are required for manufacturing. We are currently working with USCAR, a consortium of automobile manufacturers, to reduce nitrogen oxide emissions as part of "lean burn" engine technology.

In addition to being able to produce such aerogels, LLNL can computer-model the effects

We have successfully investigated many different catalytic reactions.

Metal	Matrix	Catalytic process
Ti, V, Zr, Nb, Ta, W	Silica	Partial oxidation
None	Tantala	Partial oxidation
Pd	Tantala	Combustion
Pd/Nb	Silica	Combustion
Cr/Ti	Silica	Polymerization

of incorporating various metals into aerogels, and synthesize and test model compounds. In doing so, we can gain an understanding of catalytic processes, develop novel catalytic materials, and simulate their use in engine systems and other catalytic systems.

LLNL catalyst technology has many other applications, including fuel additive research and production, conversion of methane to gasoline, and possible applications comparable to the use of zeolites in the plastics industry. Possible noncatalytic uses of metal oxide aerogels include insulation, acoustic range finders, and improved audio speakers.

**Availability:** This technology and our research capabilities are available now. LLNL is seeking industrial collaborators to apply this technology to specific, custom applications. LLNL facilities, including differential flow and photochemical reactor systems, and ultra-high-vacuum thermobalances are available for such collaborations.

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